RECLAMATION era

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RECLAMATION era

Kathleen Wood Loveless, Editor

Contents

COVER. Palm trees reflecting in a shimmering pool of clear water not only describes a Hawaiian beach, but also a Bureau of Reclamation reservoir, Lake Cahuilla, Calif.

United States Department of the Interior
Rogers C. B. Morton, Secretary

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Resembles
a Hawaiian resort,
but is a
Reclamation
reservoir.

recreation in the desert

By EUGENE E. HERTZOG, Chief Photography Branch, Lower Colorado Region, Boulder City, Nev.

Lake Cahuilla (Kaw-wee-yah), terminal reservoir for the Coachella Canal near Indio, Calif., has been developed into a modern recreation area providing boating, fishing, swimming, camping, and picknicking, and attracts over 5,000 visitors weekly.

Indio, a winter resort area, is 22 feet below sea level and receives less than 3 inches of rainfall yearly. Water-oriented recreation facilities for local residents are somewhat limited, except for the Salton Sea, 25 miles to the east. Nestled against the Santa Rosa Mountains, the 135-acre Lake Cahuilla is the nucleus for a park area for all to enjoy and supplements what nature neglected to provide.

For All To Enjoy

Edward A. Lundberg, Regional Director, Lowe Colorado Region, representing the Bureau of Reclama tion at the park dedication on February 12, 1972, said "This beautiful lake was created in this desert settin for all to enjoy—the affluent and less affluent, th young and the old—people in all walks of life. It is multipurpose bonus which characterizes the Reclama tion program, and we in Reclamation share your prid in the creation of a facility that serves both the irriga tion and recreational needs of the Coachella Valley."

The park is the culmination of years of planning among county, State, and Federal agencies. Th Coachella Valley County Water District, the Riversid County Parks Department, the National Park Service and the Bureau of Reclamation all cooperated in th effort.

Canal Completed in 1948

The Bureau of Reclamation completed the Coachella Canal in 1948. It serves over 52,000 irrigated acres in the Coachella Valley County Water District; over 300,000 acre-feet of irrigation water were delivered last year. Colorado River water flows into the valley through a 160-mile-long canal system ending on the west side of the lake.

As a terminal reservoir, the lake contains a ready reserve of 1,500 acre-feet of water that can be drawn for emergencies. The canal flow capacity of 2,600 acre-feet per 24 hours can refill the lake in a few hours. The kidney-shaped lake is three-fourths of a mile long and about one-half that size in width. There are 5¼ miles of shoreline.

Named After Ancient Lake

Lake Cahuilla was named after the ancient Lake Cahuilla, a vast fresh-water expanse three times larger than the Salton Sea. Both lakes were named after the peaceful Cahuilla Indians, who lived, hunted, and fished along the shore of the ancient lake before white man arrived. Descendants of the early-day Indians still live in the Coachella Valley.

Left. *These youngsters find great pleasure playing ring-around-the-rosie on the newly created beach of Lake Cahuilla.*

Top, Before. *The Coachella Valley was without a body of water sufficient for recreational use.*

Bottom, After. *Lake Cahuilla now provides boating, fishing, swimming, camping, and picnicking for 5,000 visitors per week.*

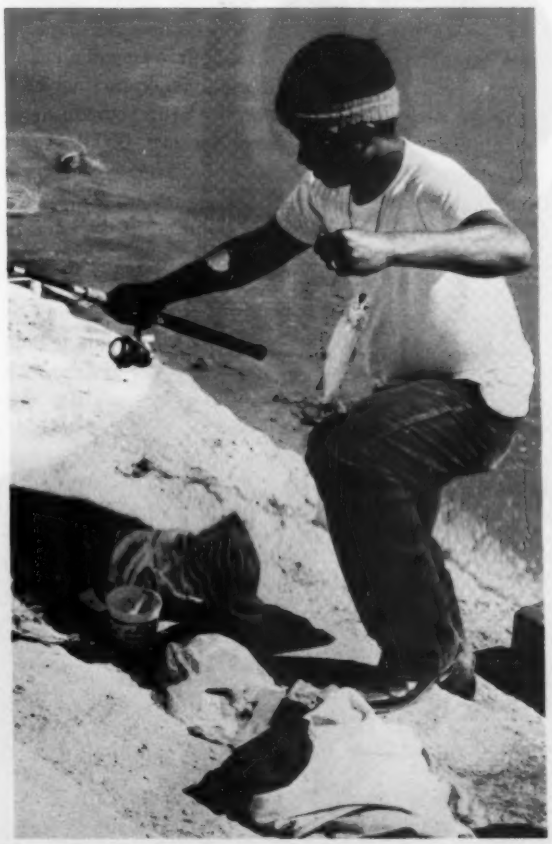
Fishing in Cahuilla

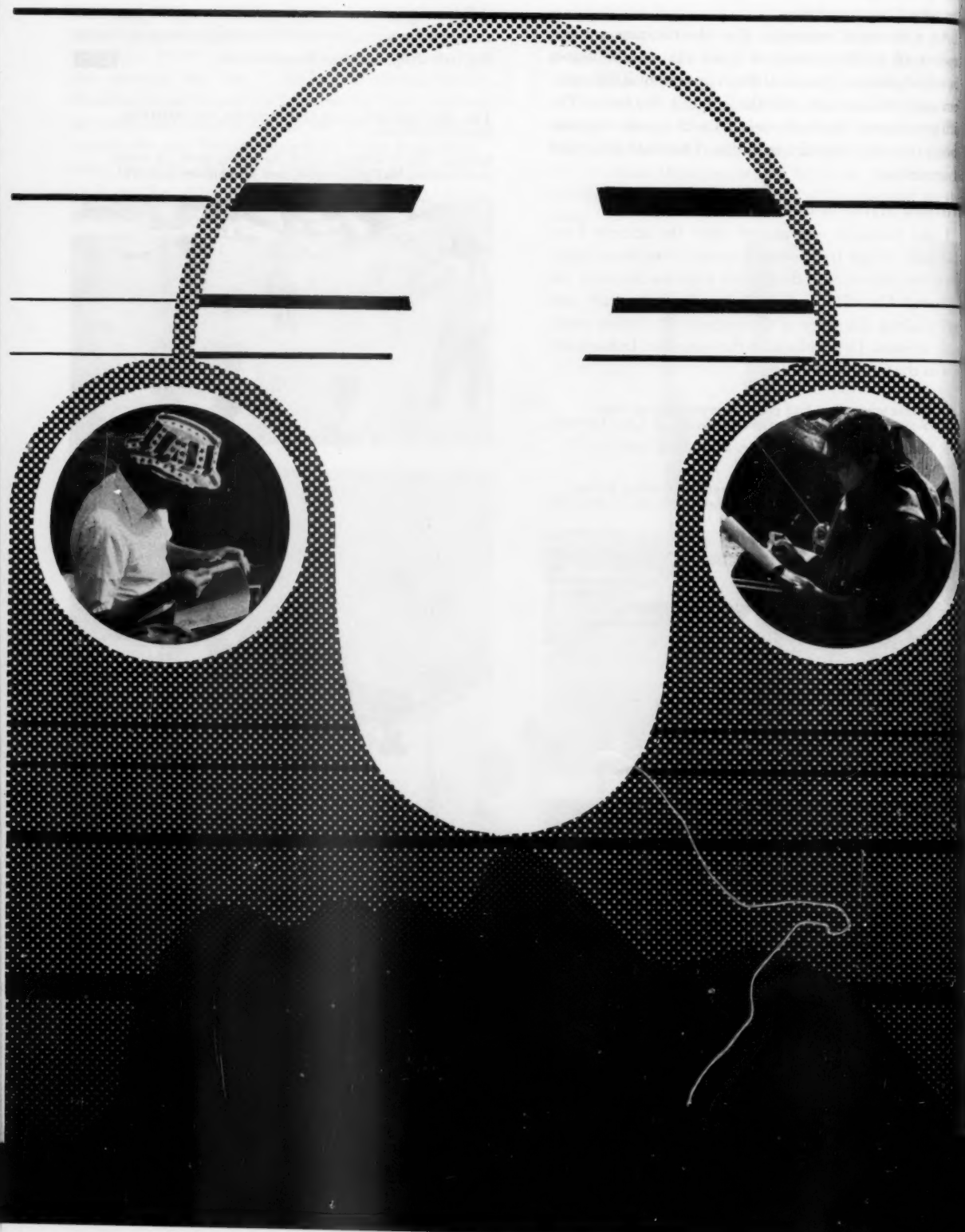
Fishing has been popular since the lake project began. In warmer months, bass, bluegill, catfish, and crappie are planted. In the winter when the water is cold, trout fishing is excellent. Stocking the lake is a responsibility shared by the County Parks Department and the State Department of Fish and Game.

Future plans for the park include a 300-pad, 140-acre compground, as well as expanded boating facilities, bait shop, and snackbar services.

Top. *Recreationists of all ages enjoy the cool refreshing lake in the desert.*

Bottom. *This fisherman found the fishing good. In warm months bass, blue gill, catfish, and crappie are plentiful.*





A SEARCH FOR MAN'S PAST AT LIND COULEE

By CAROL PROCHASKA, Administrative Assistant to the Project Manager, Columbia Basin Project Office, Bureau of Reclamation

Fifteen dust-coated young people spent 6 weeks last summer toiling under a scorching sun, searching for clues to man's early existence in the Columbia Basin of central Washington.

The searchers were members of a crew exploring the Lind Coulee archeological site, first identified and excavated by Dr. Richard D. Daugherty in 1951–52. The project is under the direction of archeologist Dr. Henry Irwin and his wife, Anne, who is an anthropologist. It is being carried out through a contract with the Washington State University Department of Anthropology and the National Park Service, and is funded by the Bureau of Reclamation, which owns the lands involved.

The Lind Coulee site is located within the Columbia Basin project, which is being built by the Bureau.

The project area is part of the Columbia Plateau, a geological feature formed 15 to 30 million years ago when many huge cracks 30 to 50 miles deep opened in the earth's crust, and molten lava flowed out and over the land like a hot brown syrup.

The repeated flows covered many miles; then the outpouring stopped and the lava cooled into a nearly flat basaltic surface. The maximum depth of this basaltic material is not known. However, deep wells indicate it exceeds 1 mile in thickness throughout much of the area.

Landscape Changes

After the lava outpourings ended, there followed a period of millions of years during which the Cascade Mountains were uplifted and the eastern part of the State of Washington sagged under the weight of the basaltic flows and sediments, forming the present basin.

About 1 million years ago, the earth entered the Pleistocene Epoch or the Ice Age, as we laymen know it. During this time, a huge ice sheet which started in Canada moved south over the central Washington area.

Long fingers of the ice sheet flowed down the valleys. The ice completely filled the Columbia River gorge from Okanogan to Grand Coulee Dam to a depth of nearly 5,000 feet in some areas before the glacier started to recede by melting. Another ice dam to the east created a temporary lake that impounded a huge volume of water in the valleys of western Montana.

Floods Cover Parts of Washington

The water in the valleys finally became so high that it spilled out in great floods, covering the entire east-central Washington area, washing away much of the soil covering the lava rock, and cutting great chasms in the basaltic material. Layers of silts, sands, and gravels, ranging in thickness from a few to over 100 feet, were deposited in some areas. Some of these are still visible in the Lind Coulee area.

A Lake Remains

Following the flood, a vast lake briefly filled the basin and, later many depressions remained full of water until they were either drained by downcutting their outlets or they were dried up during the arid years since the Ice Age.

Consequently, the area supported a large population of grazing animals for a few thousand years, making it ideally suited to human habitation. The beds of these

Top. *Dr. Raold Fryxell, geologist, points out a bone fragment found at the Lind Coulee archeological site during excavation which took place last summer and will take place this summer.*

Bottom. *Helen Fryxell, laboratory assistant, shows George Clark, Columbia Basin project conservation agronomist, some of the materials recovered by screening silts found at the site.*

ancient lakes contain fossil shells testifying that the was a day when water was more abundant than is today.

It is believed that the Lind Coulee site is near large spring at the confluence of two prehistoric cre beds, and thus was a favored campsite of early hunte In the dry, fine silts and gravels of the area, the mat rials left behind by these campers remained in goo condition until recently.

However, with irrigation of nearby lands, whic began nearly 20 years ago, water entered the are and there is evidence that bones and other ancie materials are deteriorating and must be recovere soon or be lost.

This concern prompted the Bureau of Reclamatio to provide funds for the excavation. In 1972 the Was ington State University team worked from July 1 unt the middle of August. Additional work will be don in the summer again with the Bureau's support an cooperation.

The first step in the 1972 exploration was to identif the area worked by Dr. Daugherty's team 20 years ag The map, showing the artifact locations discovered a that time, provided information used to determin which areas were now to be excavated.

Local Citizens Assist

At the beginning of work at the site, a borrowe bulldozer was used to strip overburden from the si and a backhoe was used to dig a trench 30 yards lon which exposed soil deposits as much as 18 feet belo the surface. Both pieces of equipment were loaned b generous local citizens. Additional support came fro the City of Warden, only a few miles from the site which set aside the top floor of the city hall for use a a laboratory.

After trenching, the site was laid out into 2-mete squares so artifacts and other materials found coul be precisely located on a map. Some of this mappin was done with the use of a computer-graphic devic made available by the National Science Foundation

Soil and other materials were carefully removed b layers, a square at a time, and then water-screened t recover any valuable remnants of the past. Significan items, such as animal bones and artifacts, were left i place until their extent and the significance of thei position could be judged and recorded.

For example, when a rib bone thought to be fro an elk was exposed, it was left in place until the so around it had been removed and examined. Subse quent work in the immediate area revealed part of th skull of what appeared to be a young bison, and so both bones were left in place until further associations coul be noted.

Pits being excavated near the Lind Coulee wasteway can be seen in the middle background to the right of the wasteway. In the foreground, Helen and Raold Fryxell work at the water screening table used to separate artifacts and other archeological materials from silts.

More Discoveries

Other discoveries include several flakes or chips of stone, such as a 4-inch-long piece of calcedony (a semi-transparent stone similar to agate) and an arrowhead-like point shaped from a hard yellowish stone; the tiny jawbone of a ground squirrel; pea-sized shells of clams; and both dryland and fresh water snails.

In one area south of the archeological site, a 5-inch deep deposit of tiny bones, a number of 1-inch diameter balls and other materials were found. The small balls are believed to be feathers, bones, and other indigestible parts of prey which were eaten by owls and then regurgitated. The team speculates that a colony of owls nested in burrows above these deposits.

Fish Spear?

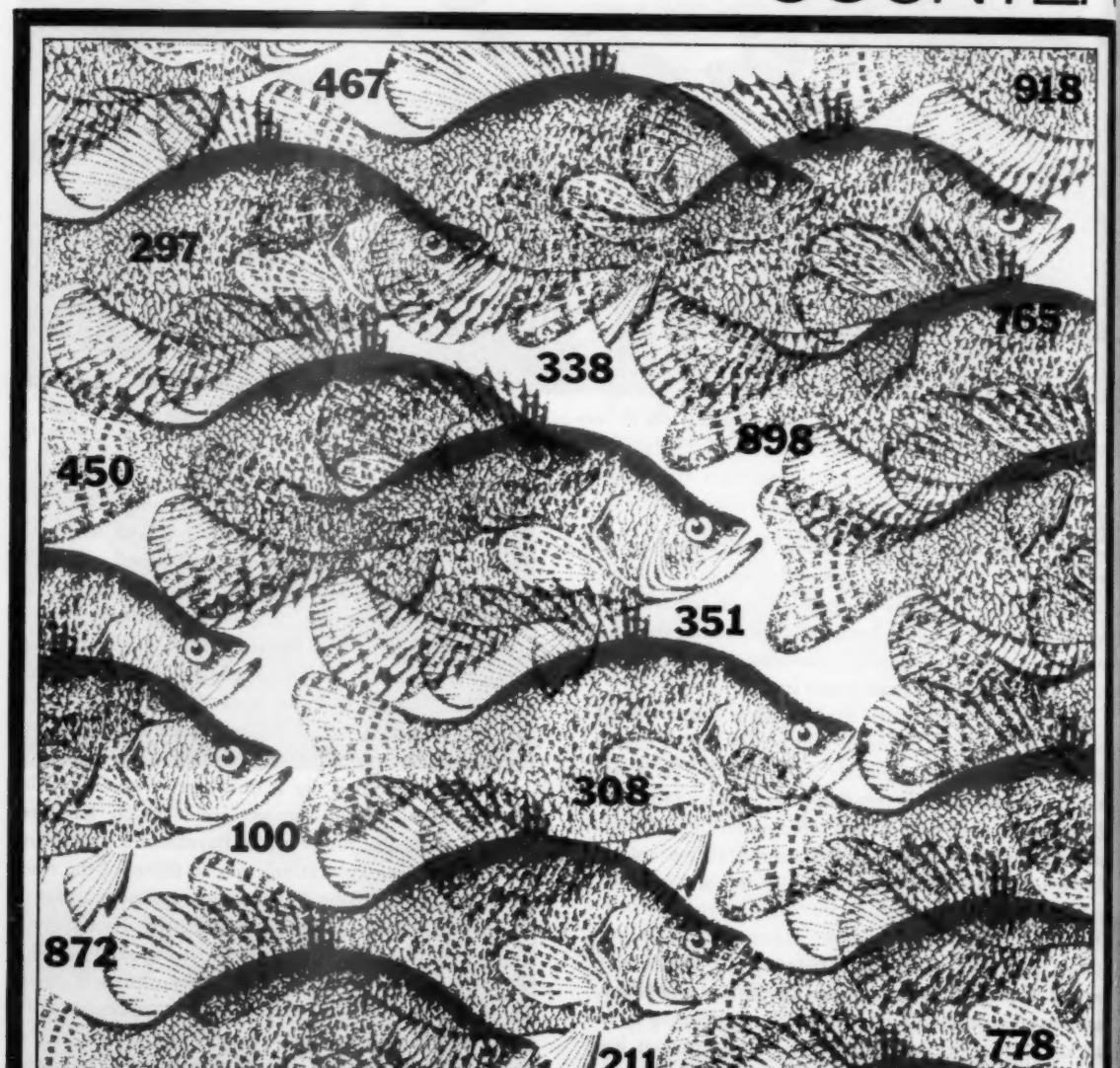
Two especially interesting artifacts were found near the end of the 1972 summer dig. The first is a notched, harpoon-like projectile which Dr. Irwin believes to be part of a three-section fish spear. The second is less easily identifiable and consists of two rib bones closely fitted together and which may have been used as a flaking tool.

Among the most significant discoveries made at the site was that of materials indicating human habitation in the area about 6,000 or 7,000 years ago. This is at least 2,000 years more recent than that with which Dr. Daugherty's 1951–52 work was concerned, which by subjecting some of the materials to the then newly discovered carbon dating process was estimated to be about 8,000 years ago. The earlier stratum may indeed be even older than this estimate since artifacts found there are similar to those unearthed at the Marmes Site on the Snake River a few years ago which are thought to be close to 10,000 years old.

The Lind Coulee dig is only one of several within the Columbia Basin project area which has been funded at least partially by the Bureau of Reclamation. Others include exploration prior to filling of the reservoir area behind Grand Coulee now called Franklin D. Roosevelt Lake; the excavation of the Fort Colville site in 1971, and several sites on the Spokane Arm of Franklin D. Roosevelt Lake which were worked during the drawdown of the reservoir for construction of the Grand Coulee Dam Third Powerplant.

As work progresses on the million-acre irrigation development, other areas having potential archeological significance will be surveyed and explored to prevent damage or destruction to the clues to man's past that may be found there.

INSTALLING A SONAR FISH COUNTER



Bureau Counts Fish To Learn Of Their Activities

By ERNEST SASKI, Civil Engineer and JOE DAHILIG, Photographer, Bureau of Reclamation, Mid-Pacific Region

"There are always more fish in the sea," a common figurative statement, was recently explored by a group of engineers who questioned not the statement's figurative but rather its literal meaning.

These engineers were not so bold as to ask how many fish swim the mighty sea, instead they asked how many fish swim California's Trinity River. Here is the story.

In its effort to improve uses of western waters, the Bureau of Reclamation continually seeks new methods to enhance these uses. One particular method to improve the uses of water is to eliminate fish resources problems. Information relative to such problems is vital. For example, if the numbers of anadromous fish using selected streams could be determined, questions concerning mitigation and enhancement of fisheries could be resolved more easily.

Sonar Fish Counter First Used in Alaska

Seeking the answer to the question of how many fish swim selected streams is why the Alaska Department of Fish and Game purchased a sonar fish counter. Used on an experimental basis, the counter performed with 85–90 percent accuracy.

Although still undergoing continuing development, the counter spurred an "offshoot"—a smolt counter. The smolt counter is used in Alaska and demonstrates a high degree of accuracy in counting Sockeye smolts ranging from 70 to 130 mm in length.

California's Counter

California also needed to know the number of anadromous fish using selected streams. So the Bureau of Reclamation, in cooperation with the Bureau of Sport Fisheries and Wildlife and the California Department of Fish and Game, installed a salmon counter on an experimental basis in the Trinity River near Lewiston, Calif.

Counter Description

The salmon counter consists of two major parts: the shore-based electronic system and an array of 30 transducers placed on the river bottom perpendicular to the river flow. The system emits short bursts of high-frequency sound and then "listens" for an echo for a duration of time corresponding to a range of 3.25 feet.

Salmon passing over the array when migrating upstream to spawn reflect this pulse to the transducer which counts each echo on a numerical readout. A 4-or-more pound salmon produces an echo adequate to cause a count. Larger salmon still result in a single count because once the system threshold has been exceeded, the signal processing precludes more than one count.

The pulse repetition rate is fixed and has been determined by observing salmon ground velocities in various Alaskan rivers during salmon spawning migrations. This has been measured at 1.75 feet per second ± 10 percent (ground speed) and is quite consistent in spite of variation in water velocities. Any deviation from this velocity would cause an error in the count because the salmon would be subjected to more or less than 1 pulse per fish passage.

The system accuracy is statistical, rather than actual, since some salmon are completely missed and others are overcounted because they linger or pass over the array in a non-perpendicular direction. Another cause of missed counts or overcounts is that the arc shape of the beam pattern results in overlapped beams and spaces where there is no beam, or as they are called, "accoustic holes."

These small "accoustic holes," through which salmon can pass undetected, are compensated for by the slight

overlapping of the transducer patterns. The system detects salmon passing in the lower 3.25 feet of the river, which is the sector through which salmon migrate in streams to spawn. This has been observed in river depths as great as 9 feet.

Transducer Array

The transducer array consists of a plastic, ladder-like structure containing 30 "rungs" spaced at 20-inch intervals. Each "rung" contains a transducer aimed offshore and angled upward 45°. The side rails of the array are hollow and watertight. The array is buoyant and can be floated into position, and restrained by guy cables.

When perpendicular to the river, the shore end of the array is held under water to permit flooding, at which time the array sinks to the river bottom. Forcing air from a scuba tank into the shore end of the array quickly emerges it for retrieval. The air forces the water out of two check valves located in each offshore rail member and the array floats. The 50-foot array is composed of 80-inch sections permitting easy transportation and quick assembly at the operation site. Thirty cables connect the 30 transducers to the shore-based electronics system.

How the System Works

The system functions as follows: a master clock causes a three-stage commutator to close a 10-pole reed relay. Approximately 4 milliseconds later (to allow for relay "bounce"), a post-high-frequency signal is routed to 10 of the 30 transducers (every third transducer). A split-second later (to allow for transducer "ringing") the system converts to a listening mode for a brief time. Any echos returned during this period are amplified and routed to a threshold detector.

Any signal which exceeds the pre-determined threshold triggers an instrument which equalizes varying fish sizes.

The voltage across this integrating capacitor is sensed by a voltage-controlled oscillator, causing it to oscillate at a frequency proportional to the charge on the capacitor. The oscillation triggers another instrument which, after buffering, drives an electro mechanical digital cumulative readout.

The subsequent clock pulse first discharges the integrating capacitor, making it ready for the next updating of information. The clock pulse also advances the three-stage commutator, causing a second 10-pole reed relay to close. The aforementioned sequence of events is repeated except that a second group of 10 transducers is switched in.

The third clock pulse repeats the operation, switching in the third and last group of 10 transducers. The fourth clock pulse is identical to the first, repeating the cycle. The reason for this procedure is two-fold: first, it results in system economy by permitting 10 amplifiers and signal conditioners to service 30 transducers; and second, it prevents reception of the transmitted pulse by an adjacent "listening" transducer since at any given time there are two inactive transducers between any two active transducers.

Bureau of Reclamation personnel position the transducer array of the sonar salmon counter in the Trinity River near Lewiston, Cali

Battery Power System

The system was designed for use in remote areas, thus is battery powered and uses a low current. Further power economy was achieved by electronically removing the power from most of the circuits between transmissions. The power duty cycle is quite low, resulting in a low average current drain of 65 milliamperes (ma) from a 12-volt automobile battery. Depending upon the capacity and condition of the battery and the temperature of the air approximately 1 month of operation may be obtained before a recharge is necessary. A meter alerts the operator when a recharge is necessary.

The system is designed to operate between +25° F.–+100° F. The system's case is rainproof but not hermetically sealed so it is advisable to house the electronics in a box or to cover them with a tarp. For further protection, the electronics are sprayed with an anti-humidity coating.

The Auxiliary Printer

An auxiliary printer is used to record the fish passage rate. It is housed in a similar case and is plugged into the salmon counter by means of a 3-foot cable. The printer derives its power from the salmon counter regulator and has an average current drain of 2.9 ma.

A switch permits the operator to select either 5-, 10-, or 15-minute "printouts." The readout differs from the salmon counter in that, after printing the number of counts that have occurred during the selected time, it resets to zero. Thus, a chronological record of fish passage is available. Additional benefits of the printer are as follows: in some rivers, large amounts of debris, such as tree branches, catch on guy cables and are within the sonar beam of a transducer. This, of course, causes a continuous false count. The salmon counter readout is cumulative but the printer records a sudden great increase in counts easily detected by the operator. The previously valid data are thus preserved and used instead.

Another benefit of the printer is that it records any large number of counts occurring during a heavy rainstorm or passage of a boat. Motorboats will put much air into the water, causing as much as a thousand counts. Such an occurrence is obvious since it occurs during one printout only. The remaining valid data would then be used in place of the erroneous data.

Surface Inhibitor

The surface inhibitor, a relatively recent development, is plugged into the main salmon counter printed circuit card. It detects a water level decrease caused by tidal effects and it automatically reduces the range

This closeup of the salmon counter printer shows the "printout," which could provide a continuous count during salmon runs.

of the shore-end transducers to prevent false counts from water surface reflections.

To continue to control the range, the surface inhibitor controls the shore-end first 12 transducers in groups of three. For example, when the water level drops, the first three shore-end transducers would usually be the shallowest. If the level drops to the pre-set range of 3.25 feet, it is sensed and the range of only the first three transducers is automatically reduced to 1.5 feet. This prevents false counts from surface reflections, but causes a large undercount of any fish passing over these three transducers because the transducer beam pattern overlap no longer exits and large "acoustic holes" are present.

Fifteen seconds after the water rises, the surface inhibitor automatically raises the range of the first three transducers back to 3.25 feet. If the water level continues to drop, the next three transducers would automatically sense this and then the range would be reduced to 2 feet. A further drop would reduce the range of the next three transducers to 2 feet, and then the next group of three transducers to 2 feet. Thus, the first 12 of the 30 transducers would be protected from false surface counts, while not affecting the range and acoustical coverage of the remaining transducers in the system.

In Summary

The sonar fish counter is of great benefit in obtaining data about the number and migration habits of fish using selected streams. With the auxiliary printer and the surface inhibitor, greater accuracy and more reliable data may be obtained. Even though only in the experimental stage, these instruments show great promise for continued research toward alleviating fish and water resource problems.

Reclamation
Art
Program
is a
success
and
on the move

RECLAMATION & THE CREATIVE ARTIST

By JOHN DEWITT, Art Program Director, Bureau of Reclamation, Washington, D.C.

When the National Gallery of Art in Washington, D.C. opened in March 1972 an exhibition of paintings created by contemporary American artists commissioned by the Bureau of Reclamation, it marked a unique milestone in the history of the Federal Government's participation in the visual arts.

The exhibition was the culmination of an art program totally unlike its well-known predecessor, the Works Progress Administration*(WPA) Fine Arts Program of the 1930's. Anyone whose memory goes back to those Depression years will recall that the WPA art program, like so many other combined work and welfare programs of those lean years, was born of an urgent need to provide jobs and thereby help lift the country out of its economic doldrums.

But the Reclamation art program was launched with a totally different rationale. A Federal agency sought the assistance of established creative artists to convey the meaning of its programs to the general public. Rather than the Government helping the artists, as in the WPA days, here is a case where artists were asked to help the Government.

Art and Water Conservation?

Since the projects of the Bureau of Reclamation are totally concerned with the development and conservation of the water resources of the western United States, the Bureau's mission can be considered entirely technical. Therefore, the addition of an art program to the Bureau's activities might seem to be an anomaly. Yet the Bureau's mission can logically be considered a creative as well as a technical one—in that the water the Bureau's developments provide has changed the face of the American West and brought about new ways of life for its inhabitants. In so doing, the Bureau has created a new environment.

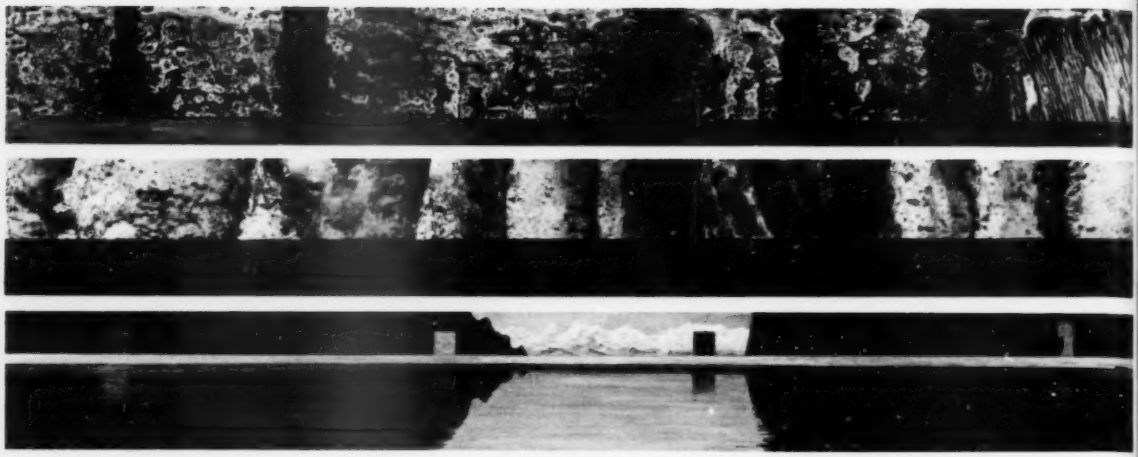
This creative aspect of the Reclamation program is what the painters were asked to depict. They were never asked to glorify in paint a dam, a canal, a powerplant, or any other man-made structure. They were merely shown around Reclamation project areas they chose to visit, their questions were answered, and

*In 1939, the name was changed to Work Projects Administration.

Above. *A flock of fowl circle over Tule Lake, Calif. as illustrated in John McCoy's* Tule Lake Wildlife Refuge.

Left. *Ethel Magafan, an artist commissioned for the Bureau's art program, paints a scene along the Palisades Reservoir on the Minidoka project, Idaho.*

Artist, Lamar Dodd of the University of Georgia sketches a scene at Mary's Lake, a reservoir of the Colorado-Big Thompson project, Colo.



Michael Frary's
Hungry Horse—Shoreline,
Hungry Horse— Reservoir,
and
Hungry Horse—Dam.

then they were free to choose their subject matter and depict it in whatever style or manner they deemed appropriate. Illumination of the subject matter rather than illustration of any physical objects, man-made or natural, was the goal of the program.

Abstract or Semi-abstract

The artists who were invited to join the program were told that if their reactions to their material could best be expressed in abstract or semi-abstract terms, this approach would be fully as welcome as the representational approach.

It was clear that the Bureau wished to commission not their skills alone, but their perceptions and imaginations as well. Since these things must remain entirely personal, no further attempts at guidance were offered. This approach succeeded in achieving its hoped-for results: the creation of a collection of paintings able to stand on their own merits as works of art quite aside from their subject matter.

The enthusiastic support given the program by Secretary of the Interior, Rodgers C. B. Morton attests to its success in achieving its objectives. "While I was a strong supporter of the concept of an art program for the Bureau from the very beginning," Secretary Morton said, "it wasn't until I attended the opening of the exhibition at the National Gallery of Art that I was struck by the full significance of the program. There, hanging on the walls, were paintings by some of the greatest contemporary artists in America—each expressing, in the artist's individual way, his own imaginative reactions to the Reclamation program of bringing water from where it is to where it is needed.

"Not one of the paintings was trying to tell a story as magazine illustrations do; each one was first and foremost a work of art. But taken all together, the paintings succeeded in conveying the spirit of the Bureau's mission in a fashion that had never been done before. If I ever needed proof of the old adage that one picture is worth a thousand words, that exhibition supplied it."

Some 40 American painters have participated in the art program. They were selected upon the advice of Dr. Lloyd Goodrich, for many years Director of the Whitney Museum of American Art in New York City. The commissions offered to the painters were a minimal amount above travel and living expenses given them while visiting the sites of Reclamation projects on sketching trips; the total was far less than the artists regularly receive from sales through their galleries and dealers. Nevertheless, the majority of the painters invited accepted the profferred commissions.

Why Artists Accepted

In some cases the deciding factor was the opportunity to visit some of the most scenic areas of the Western United States, and to view those areas by helicopter, boat, jeep, or whatever means of transport that would enable them to absorb the total experience.

In other cases the compelling motive was the artist's interest in encouraging the Federal Government to participate more in the fine arts. By making the Bureau's art program a success, they felt, they would be stimulating the initiation of future Federal art programs, perhaps on a larger and more remunerative scale. For this reason the painters gave unstintingly of their most creative endeavors.

Bureau's Program Began in 1969

The Bureau's art program was launched in 1969. To date the Bureau has compiled a collection of over 360 oils, acrylics, watercolors, and drawings from the contributing painters. A selection of 70 of these premiered at the National Gallery of Art from March 25 through May 28, 1972. The exhibition was seen and acclaimed by thousands during its show at the National Gallery.

It is beyond the powers of this writer, perhaps of any writer, to convey accurately in words a visual impression of the exhibition. Painting is one form of expression, and language is another. Each has its own disparate function; what can be tellingly expressed through the medium of painting is at best only lamely communicable in words, and vice versa.

It is hoped that *Reclamation Era* readers will have the opportunity to view the Reclamation art exhibition and exercise their own judgement as to its merits and messages. To give this opportunity to the public, the exhibition is now on a tour of art museums across the country under the auspices of the Traveling Exhibitions Service of the Smithsonian Institution.

Museums that have booked the Reclamation art exhibition and the dates when it can be seen are listed below. Additional listing will appear in a later issue of the *Reclamation Era*.

Readers may also be interested in the portfolio of the art reproductions which is available from the Government Printing Office and may be ordered on the order blank found on the back cover of this issue.

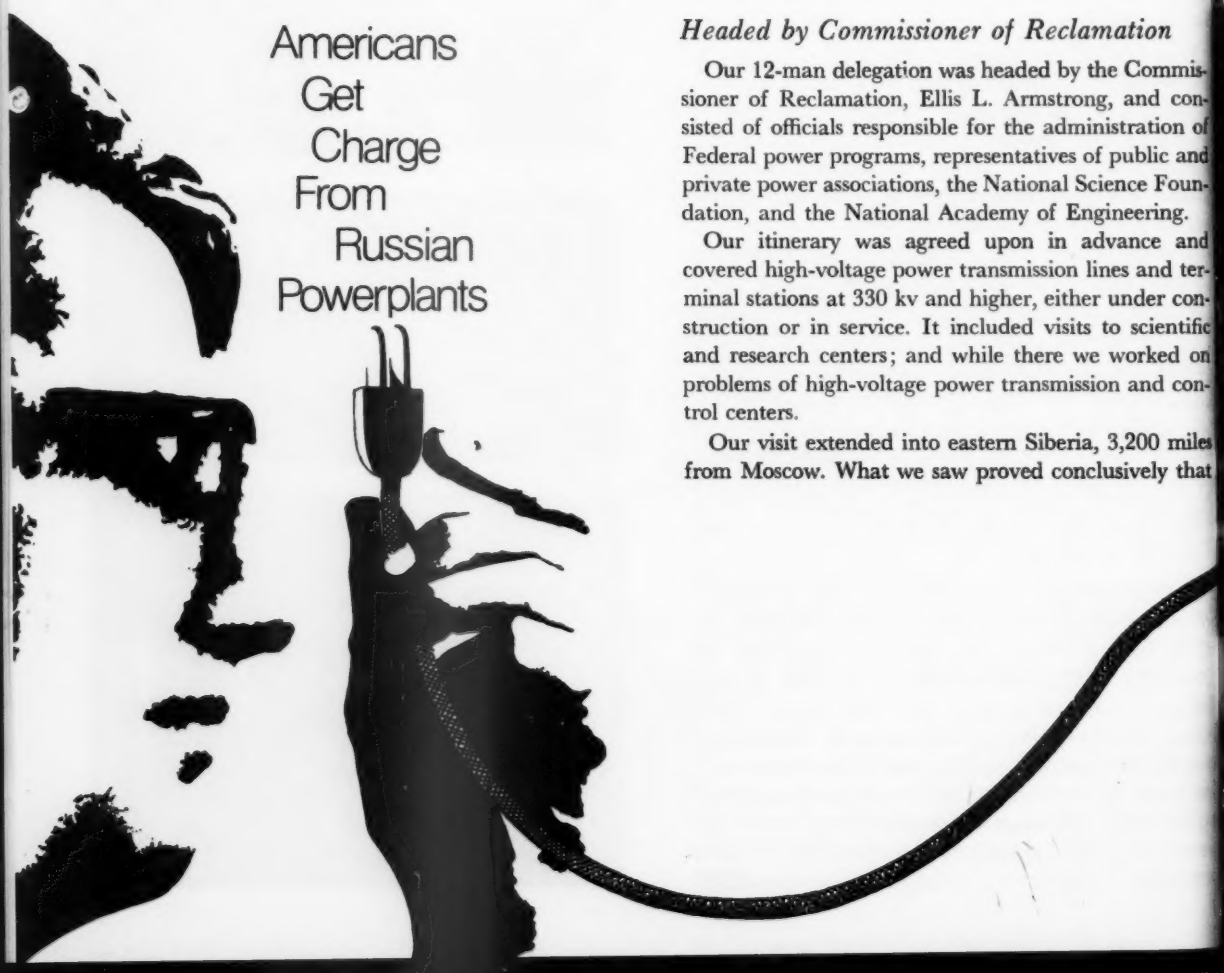
Even at the modest price of $4 each, the phenomenal sales of these portfolios have gone a long way towards defraying the cost of operating the art program, much in the same fashion that repayments by water and power users defray the costs of other Reclamation programs.

Reclamation Art Program Schedule

Dane G. Hansen Foundation, Logan, Kans.
May 5 to June 3, 1973
Tennessee Fine Arts Center, Nashville, Tenn.
August 11 to September 9, 1973
Hunter Gallery, Chattanooga, Tenn.
September 17 to December 16, 1973
Yellowstone Art Center, Billings, Mont.
November 17 to December 16, 1973
Palm Springs Desert Museum, Palm Springs, Calif.
April 13 to May 12, 1974
Southeast Arkansas Arts and Sciences Center, Pine Bluff, Ark. June 1 to June 30, 1974
Witte Memorial Museum, San Antonio, Tex.
July 20 to August 18, 1974

Top. *Norman Rockwell sketches Rainbow Bridge, Utah.*
Center. Gibson Dam *by Ethel Magafan*
Bottom. Inside the Turbine *by Fletcher Martin*

Americans Get Charge From Russian Powerplants



By T. W. MERMEL, Assistant to the Commissioner—Scientific Affairs, Bureau of Reclamation, Washington, D.C.

Don't serve a Russian coffee, serve him tea—and if you ask for iced tea you may get a few ice cubes served on a dish or you may get none at all. And if you ask for a cold beer you may be offered an ice cube or two to chill it.

These are just a few of the multitude of things a visitor can learn while in the U.S.S.R. and they demonstrate that different people can do things differently and sometimes even better than we can.

Last July I was privileged to be a member of a technical exchange tour to the U.S.S.R. The United States and the Union of Soviet Socialist Republics have had a number of cultural, scientific, and educational exchanges. These exchanges were made possible by the 1972–73 Agreement on Exchanges and Cooperation in Scientific, Technical, Educational, Cultural and Other Fields, signed April 11, 1972. Implementation of these exchanges was in keeping with the spirit of President Nixon's visit to the Soviet Union in May 1972.

Headed by Commissioner of Reclamation

Our 12-man delegation was headed by the Commissioner of Reclamation, Ellis L. Armstrong, and consisted of officials responsible for the administration of Federal power programs, representatives of public and private power associations, the National Science Foundation, and the National Academy of Engineering.

Our itinerary was agreed upon in advance and covered high-voltage power transmission lines and terminal stations at 330 kv and higher, either under construction or in service. It included visits to scientific and research centers; and while there we worked on problems of high-voltage power transmission and control centers.

Our visit extended into eastern Siberia, 3,200 miles from Moscow. What we saw proved conclusively that

the U.S.S.R. has made tremendous investments of human energy and material resources to develop its hydroelectric potential.

The country's record of completed dams and those under construction places the Soviet Union as a leader in high dam construction. Large earth dams, which have created many of the world's largest manmade lakes, and the development of the large hydroelectric potential also rank the Soviet Union among the world's most advanced nations in hydroelectric machinery technology. This is evidenced by many of the large-capacity hydroelectric units already operating. Some are as large as 500 mw.

Moscow—The Center of All Events

Moscow is the port of entry and exit for all official visitors, and it served as our homebase during our visit to six cities. While in Moscow, we visited the U.S.S.R. Ministry of Power and Electrification, where we held several technical discussions with administrators, supervisors, engineers, and designers who were responsible for the management and construction of the entire electrification of the U.S.S.R. We found the discussions frank and open and there was a demonstrated willingness to provide answers to many of our technical questions.

We were fortunate to spend a good amount of our time in the capital city. This gave us an opportunity to learn more about its people, history, and culture.

The Kremlin

We visited the Kremlin, which has within its walls many ornate cathedrals—monuments to the religious background of the ancient rulers, the czars. Some date back to the fifteenth century. On Red Square outside the Kremlin Wall, stands the impressive Saint Basil's Cathedral, with its multicolored domes. It carries the legend that its architects upon completion of their works were blinded by the czar so that another more beautiful cathedral would never be built.

Those of us who looked for mementos to take home found the experience of shopping in the GUM (Governmental Universal Magazin) Department Store a greater thrill than what could be purchased inside. Oddly enough, many of the products in the elaborate window displays were not available for purchase in the store. This may have occurred for two reasons. First, many such products displayed are sold exclusively to tourists for hard currency and second, since the demand is so high, some of the products are available only immediately following the infrequent factory deliveries.

We were confronted with familiar sights where crowds of women surrounded kiosks (small shops within the department store) when special items had just arrived. This reminded us much of our own bargain sale where battles are fought over sale items. It convinced us that people are the same everywhere, at least in some respects.

The Lenin Mausoleum

The sharp lines and dark marble of the Lenin Mausoleum stood out in contrast to the Kremlin Wall surrounded by long lines of patient humanity waiting to get a glimpse of the country's worshipped hero. One member of our delegation stood in line 4½ hours to visit Lenin's Mausoleum. I, too, joined the worshippers but for reasons of curiosity. It *was* an exciting experience.

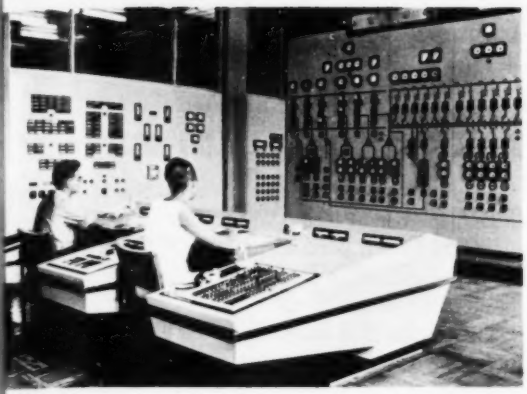
We also visited the Moscow metro with its elaborately marble-lined stations, each architecturally decorated differently so that people could recognize the station by its character. There is no doubt that it is an engineering wonder.

While the Bolshoi theater was not performing in Mosscow, the delegation did see a ballet in Leningrad and an opera in Volgograd. The artists were magnificent, both evenings well worthwhile.

Chagino Substation

The delegation visited the Chagino 500-kv substation outside Moscow. This station is one of six 500-kv substations interconnected and forming the Moscow 500-kv ring. The power to the 500-kv ring is supplied from the Volga hydroplants approximately 600 miles to the south and east. Many thermal plants located in the north feed into this system.

The substation is one of the older types, having been built 15–20 years ago. By U.S. standards, the housekeeping in the substation yard was substandard. The concrete was badly spalled, paint was peeling, and the ferrous metal parts were rusting. The noise level was



Top. *The central control board at the Bratsk hydroelectric plant is operated by one of many Russian women operators.*

Bottom. *Konakovo Steam Plant smokestacks support transmission line crossover.*

Left. *This model of the Krasnoyarsk hydroelectric powerplant, the largest operating in the entire world, gave the delegation a idea of how it appears—they were not allowed to view it first hand.*

high from corona and transformers. We were informed, however, that the required degree of performance reliability is maintained.

We were told that some of their problems are similar to ours. Vandalism due to gunshot damage is common. When culprits are apprehended, they are required to pay the cost of repair of equipment damaged or receive heavy sentences.

We were advised that Russia has adopted a policy that for every tree removed from a transmission right-of-way, ten others are planted elsewhere out of the line area.

Central Dispatching Center

On the second day of touring, we visited the Central Dispatching Center in downtown Moscow. The Center has a large display panel covering one wall, depicting the Soviet transmission system with mimic buses and indicating lights. Facing the panel are three operators' desks with communication facilities to the subdispatching centers and instruments indicating line quantities.

We did not see any automatic load-frequency or tie-line control. Hence, we concluded no such equipment is in operation. There was no remote control for the dispatching center. Computer equipment of the magnetic drum type was used for off-line calculations but not for control.

The entire European portion of the Russian system is dispatched from this Center. The system serves approximately 175 million people and has a capacity of 120 million kw. Many women as well as men work in system dispatching and computer control programming.

Approximately 81 percent of the electric energy is provided by thermal plants in the U.S.S.R. with 18 percent from hydroplants and one percent from nuclear plants. The 81 percent thermal power is provided about equally from coal-, oil-, and gas-fired furnaces. We were told that in the next 10 years most additional power will be generated by thermal plants.

Elektro–72

While in Moscow, we visited the fairgrounds of Sokolniki Park to view the Elektro–72 international exhibition, where we saw electrical equipment and high-voltage and transmission line exhibits assembled for the international exposition.

The exposition was sponsored jointly by the U.S.S.R. Chamber of Commerce, Soviet Economic and Foreign Trade organizations, and the Executive Committees to the City Soviets. The purpose was to help representatives of Soviet and foreign business circles to establish contacts and extend trade; demonstrate the latest achievement in the design and manufacture of machinery, equipment, instruments, materials and other products; and exchange scientific and technical information.

Models were on display of a wide variety of major electrical equipment, such as hydroelectric turbines, generators, steam turbines and steam-driven generators, and large power transformers. Also displayed were prototypes of 750-kv high-voltage air circuit breakers; 50-kv oil-filled cable, glass and porcelain insulators; motors; switch-gear; and other electrical equipment.

Of special interest were the models of the Krasnoyarsk hydrogenerators. These units are rated 500 and 90 mva, 0.85 power factor, 93.8 rpm. The turbines are rated 508,000 kw, at 93 meters design head with 7.5-meter-diameter Francis-type runners.

There was also a model of the horizontal bulb unit rated at 45-mw to be installed in the Saratov hydroelectric station. Here, too, Russia has made outstanding advances and recently sold similar units to our Canadian friends.

The Bratsk hydroelectric plant houses sixteen 225-mw and two 250-mw turbines. The Bratsk Dam and powerplant are on the Angara River, several hundred kilometers below Lake Baikal.

Konakova Steam Power Station

The Konakova power station, with a capacity o 2,400,000 kw, is on the banks of the Volga River. I was built during 1964–68 and feeds into the Mosco grid by means of a 750-kv ac transmission line, 90-k long.

An unusual aspect of this power station is that eve though the height of the 750-kv bus supporting struc tures and output portals are 22 and 34 meters respec tively, the minimum clearances to the ground are ver low, only about 8 meters.

The electric field can easily be felt by anyone walkin under the energized parts and the American team wa told that the maximum time that workmen wer allowed to remain in the substation per day was 1½ hours. This safety rule was based on experiments wit animals. The Russians agreed to make available to u their reports on these experiments.

Although the substation is only a few years old, it condition was similar to that of the Chagino substatio The area surrounding Konakova was covered wit weeds and when we walked through them we definitel got a charge out of our visit.

From Moscow we went to Leningrad where w visited the Research Institute of Direct Current an the Leningrad metalworks where the world's large hydraulic turbines for the Krasnoyarsk powerplan were made. We also visited the Elektrosila generato manufacturing plant where most of the large hydro electric generators and steam turbine units are made Following that visit we returned to Moscow only t leave for Volgograd.

Volgograd Hydroelectric Power Station

Near Volgograd we saw the Volgograd hydroelectri power station. It is the last dam on the Volga befor the river empties into the Caspian Sea. It is the thir largest powerplant in the U.S.S.R., behind on Krasnoyarsk and Bratsk. It has a rated capacity o 2,541 mw, which includes an 11-mw fish attractio unit.

We were shown the fish elevator which permits th sturgeon to pass upstream of the dam for spawnin Approximately 50,000 sturgeon pass upstream b means of this elevator each year. There is also hatchery near the dam which produces 10 million fr annually.

This plant also houses the dc converter station whic consists of mercury arc rectifiers.

The dc terminal for the Volgograd-Donbass 800-k dc line is inside the powerhouse. The terminal us single-anode mercury arc rectifiers, two in series i each arm of the converter bridges. There are eigh bridge units connected in series and grounded at th center to develop a ±400-kv bipolar system. Th

bridges are rated 100 kv, 900 amperes.

A thyristor (or solid state) converter was installed in one of the bridges for testing. It was about twice as large [physically] as a corresponding mercury valve, and the thyristors were operating by a light-beam system for controlling firing.

The group was advised that the unit consisted of 240 thyristor elements, rated 1.1 kv each, and had been in operation since early 1972. The Soviets are planning a 1,200-kv-dc, solid state transmission system to connect the trans-Siberian system with the European system. We were told that the design of this line was well underway.

Krasnoyarsk—World's Largest Generators

This hydrostation on the Yenisei River unfortunately was not included in the tour. Housing 12 of the world's largest generators (500 mw each), with water-cooled generator stator windings, two penstocks for each turbine, and many other innovative features, this station had been considered a must for our delegation but Soviet representatives, for reasons that were never made clear, would not permit the U.S. delegation to visit the station.

We received vague promises that on our next trip we would be able to visit Krasnoyarsk. We did see on the television programs the dedication ceremony of the completion of the Krasnoyarsk plant.

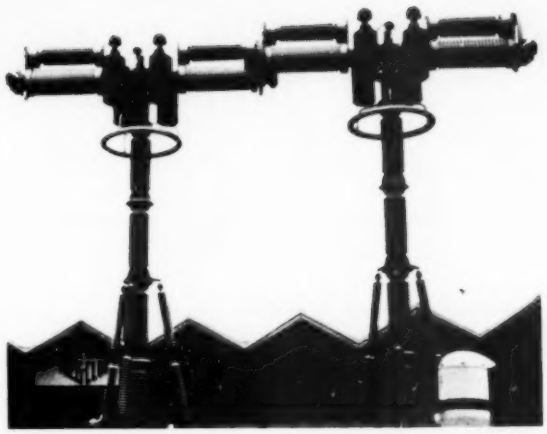
Bratsk Dam and Powerplant

After a 3,000-mile flight from Moscow eastward into Siberia, over five time zones, the delegation arrived at Irkutsk, Siberia, where we were treated to a hydrofoil boatride on Lake Baikal and dinner at a lakeside resort. This lake is considered the world's deepest at 5,315 feet and is the home of some 1,300 animal and plant species found nowhere else in the world. The area is 11,780 square miles which is about half the size of Lake Michigan.

Although the literature indicated that pollution is becoming a problem in Lake Baikal, its waters looked very pure. It was stated that the extensive wood pulp mills installed along the lakeshores have all been required to meet strict standards for purification of effluent. No more factories are to be built near Lake Baikal.

Siberia

To most of us, Siberia was synonymous with vast, desolate, barren, cold, wind-blown places. But this portion of Siberia did not fit that description. Beautiful hilly countryside covered with tall pine trees, with many lakes and meadows reminded us of Minnesota or upper Wisconsin.



Much equipment, machinery, and many instruments were displayed at the ELEKTRO–72 Exposition in Moscow. These 750-kv air blast circuit breakers were among the equipment displayed.

About 275 miles north of Lake Baikal and Irkutsk stands Bratsk Dam and Powerplant on the Angara River.

The plant has a capacity of 4.5 million kw housing twenty, 225 mw units. It is second in capacity only to Krasnoyarsk.

The Russian engineers took great pride in their plant and were eager to show us the details on how quickly one of the plants' 225-mw units could be brought on the line. The Bratsk employees remarked that it could be done in slightly over 30 seconds. In response to our disbelief, the Bratsk employees immediately accepted the challenge and provided visual proof.

Bratsk Unit No. 10 was brought to a dead halt. We were asked to stand on the unit housing then the unit was brought up from a cold start and synchronized on the line in 23 seconds. All this was accomplished automatically. All units can be started and stopped from the central control room. One engineer, with an assistant who is certified as an operator after 6 months of intensive training, was in charge of the control room. At the time of our visit the senior operator in charge was a woman.

Facts About the Country

Russia, the largest country in the world, has a total area of 8.6 million square miles (2½ times the area of the United States). Only one-fifth of the U.S.S.R. territory is in as temperate a latitude as the United States, most of the country being above the 49th parallel (the Canadian-U.S. border). Almost two-thirds lie between the latitudes of the Canadian border and the Arctic Circle and one-sixth lies north of the Circle.

The steppes of Russia make up 12 percent of the country's area and contain two-thirds of the arable

land. Contrary to general belief, much farmland is found in Siberia. For the most part, however, the climate is characterized by long cold winters and brief summers, which not only affect the growing season for agriculture, but call for extra effort and expense in the development of the country's natural resources.

With almost 244 million inhabitants, the Soviet Union ranks third in world population, after China and India. More than 200 dialects and languages are spoken, Russian being the major tongue.

Observations and Conclusions

The design of the Soviet hydroplants and equipment is comparable to the plants and equipment in America. In some respects, the mechanical components are more advanced.

The computer systems, instrumentation, and telemetering and communication systems appear to be somewhat behind Western technology.

Most of the emphasis by the Soviets appears to be on the development of very-high-voltage ac and dc transmission to meet their long-distance transmission requirements and on the development of thermal-and nuclear-powered generation. The present U.S.S.R. technology in thermal generation appears to be somewhat behind that of the West, especially where high temperatures and high pressures are involved.

The U.S.S.R. technology in design, construction, and operation of large capacity hydrounits (200-mw and above) and extra-high-voltage power transmission (705-kv ac, 800-kv dc, and above) must be ranked high—among the best in the world.

Most Impressive

Perhaps the one thing about the technical aspects of the trip which most impressed the group was the readiness of the technical staffs to discuss freely their facilities and technical problems. It was encouraging to see the freedom with which the technical problems were discussed.

Picture-taking was permitted everywhere except in the manufacturing plants and some of the generating plants and substations. Moreover, offers of reports and descriptive literature resulted in a heavy burden for the delegates.

Members of the American delegation firmly believe that, given an opportunity for continuing exchanges in the technical fields, unhampered by political considerations, the electrical engineering knowledge of both the United States and the Soviet Union would be enhanced. If more American representatives visiting Russia could speak Russian, and vice versa the program would be greatly improved.

DELEGATION MEMBERSHIP

The delegation was headed by Dr. Ellis L. Armstro Commissioner of the Bureau of Reclamation and Chairm of the United States Committee of the World Ene Conference.

Other members of the delegation were:

T. W. Mermel
Assistant to the Commissioner-Scientific Affairs, Bureau Reclamation

John E. Skuderna
Division of Power Operation and Maintenance, Bureau Reclamation

George S. Bingham
Assistant Administrator for Engineering and Constructi Bonneville Power Administration

Fred G. Schaufelberger
Assistant Chief, Branch of Systems Engineering, Bonnev Power Administration

Nathaniel B. Hughes
Director of Power Resource Planning, Tennessee Val Authority

Robert H. Bruck
Chief, Electrical and Mechanical Branch, Engineering Di sion, Civil Works, Corps of Engineers

Joseph K. Dillard
Transmission Engineer, representing National Academy Engineering

Dr. James R. Tudor
Program Manager, Advanced Technology Applications Di sion, National Science Foundation

Roderick J. McMullin
General Manager, Salt River Project, representing Ameri Public Power Association

Ross A. Segrest
General Manager, Brazos Electric Power Cooperative, I representing National Rural Electric Cooperative Asso tion

Gregory S. Vassell
Assistant Vice President in charge of Bulk Power Sup Planning, American Electric Power Service Corporati representing Edison Electric Institute

Axel Krause
Chief, Moscow Bureau, McGraw-Hill Publications Compa

WATER QUIZ

1. Which of the following contain the highest percent of water? Which the lowest?
   a. sunflower seed
   b. tomato
   c. pineapple
   d. corn kernel

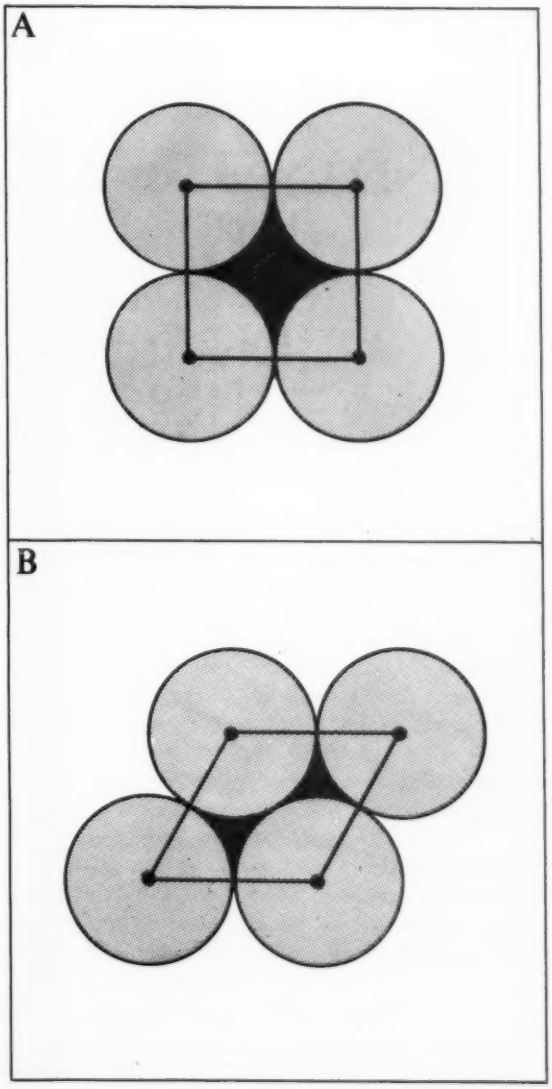
2. As a river cuts a meandering course across a plain, the water at its surface crosses in a diagonal path from one bank to the next. What is the net result of this action?

3. Groundwater roves as restlessly as any river, although its movement is often extremely slow. True or False?

4. Which of the two diagrams illustrates the most porous rock, A or B?

5. Ice is more dense than water. True or False?

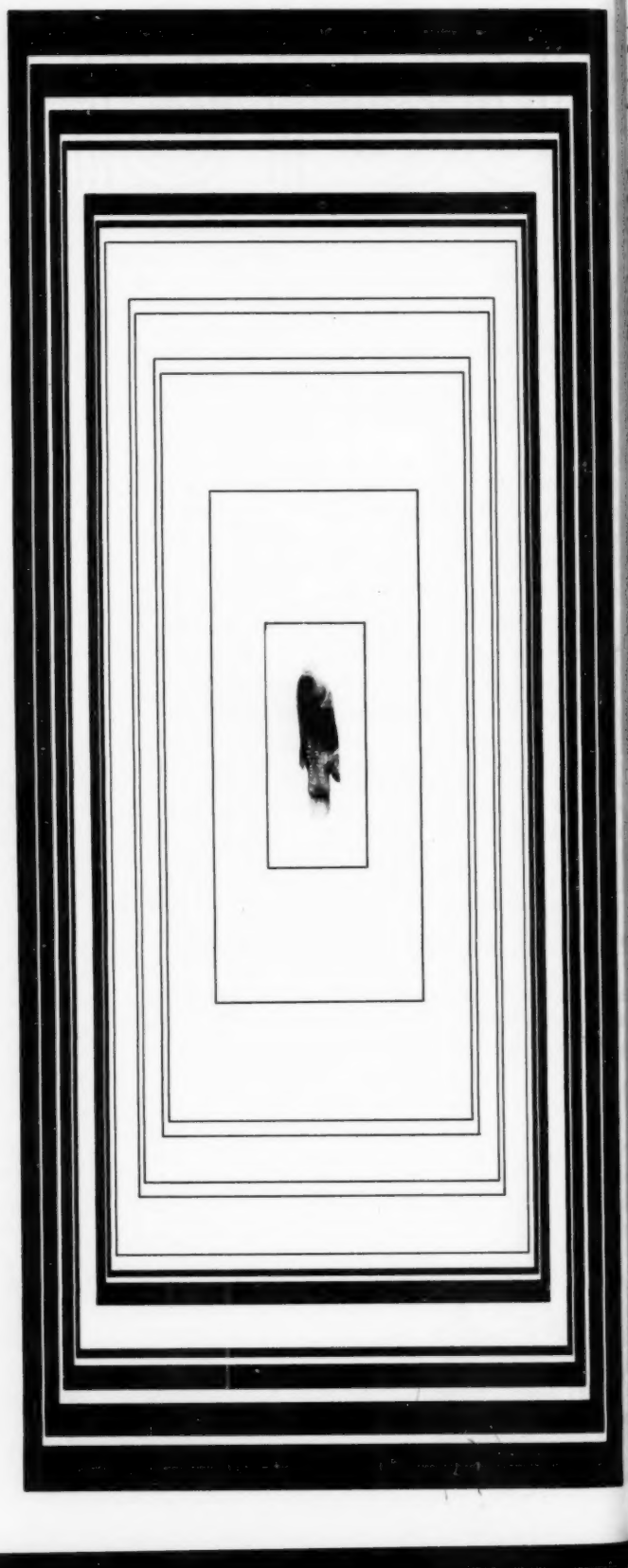
6. In the United States alone there are 3¼ million miles of river channel, yet rivers hold only—— of the world's water.



Answers on page 29.

Small fish
are given
a new lease on life.

ENDANGERED PUPFISH AT DEVIL'S HOLE



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By F. PHILLIP SHARPE and HERBERT R. GUENTHER, Environmental Office, Lower Colorado Region, Bureau of Reclamation, and Dr. JAMES DEACON, University of Nevada at Las Vegas

Rare desert pupfish are swimming, cavorating, and reproducing below the Bureau of Reclamation's world-famous Hoover Dam, but not in the Colorado River, and the "No Fishing" sign is up.

These tiny fish, averaging less than 1-inch long were successfully transplanted from their natural Devil's Hole habitat in Death Valley. Their new home is a spring-fed, warm-water, off-stream pool almost within the shadow of the 726-foot-high multipurpose dam which spans the Colorado River between Nevada and Arizona.

Beginning To Multiply

In a refugium duplicating as nearly as possible the conditions at Devil's Hole, the pupfish are thriving and beginning to multiply. The species, of which there are less than 300 in the entire world, are threatened with extinction in their natural habitat at Devil's Hole by a lowering water table. In their new environment below Hoover Dam, they appear to have been given a new lease on life.

The refugium is a rectangular concrete tank near the lower portal road bridge leading to the Hoover Dam powerplant on the Nevada side. It was built under contract by the Bureau of Reclamation through an agreement with the Nevada Department of Fish and Game and the Bureau of Sport Fisheries and Wildlife. Funds were provided by the Bureau of Reclamation and the Bureau of Sport Fisheries and Wildlife.

The refugium is fed by one of the warm springs flowing out of a sheer cliff into a ravine in Black Canyon. The pond has a 10-foot deep end and a shallow shelf 3 feet deep, and is alined along the same directional axis as is Devil's Hole to provide similar sunlight exposure.

Refugium's History

The development and operation of the desert fish refugium have a brief but very complex history, dating back about 3 years. It was approximately at this time that the plight of the Devil's Hole pupfish became of prime concern to the Desert Fishes Council.

The Desert Fishes Council is a small group of scientists dedicated to the preservation of several rare and endangered desert fish in Nevada and California. The Council brought the condition of this species to the attention of the public and made the Nation aware of the need to maintain and perpetuate the small Devil's Hole pupfish.

Through this scientific group the Bureau of Reclamation became aware of the pupfish's almost certain demise if the decline of their limited habitat continued. In November 1970, Al Jonez of the Bureau of Reclamation accepted responsibility from the Council for examining the feasibility of construction a pupfish refugium below Hoover Dam.

Pupfish's Past

The history of the pupfish extends far back into the geological history of Death Valley. Ancestors of the pupfish may have invaded the Death Valley area along the shores of an arm of the ocean which extended into the area prior to the Sierra Nevada uplift.

In any case, during the time the Sierra Nevada Range was developing, the Death Valley area received much more rainfall than it does today. This resulted in a large lake, in part maintained by the continuous flow of the Amargosa River and its tributary, Carson Slough, draining Ash Meadows. The earliest slough

Within a few feet of the Hoover Dam, the pupfish refugium houses the endangered species. This Bureau of Reclamation biologist is shown taking water temperature at the deep end of the tank.

in Ash Meadows probably contained the ancestors of the pupfish now living in Ash Meadows.

As the Sierra Nevada Range became more effective in cutting off the clouds from the Pacific, the region slowly became drier. The drainage patterns, however, continued to funnel water from literally hundreds of miles away through Ash Meadows, but erosion, weathering and other geological forces gradually left Devil's Hole above surface water and disconnected from other springs in the Meadows.

Following isolation, which occurred thousands of years ago, Devil's Hole pupfish continued to adapt to their unique environment and in the process, have come to look very different from their relatives living nearby in Ash Meadows.

Once A Warm Water Pool

Devil's Hole evolved as an isolated warm-water pool with no surface outflow. It is located at the southern

base of a low mountain ridge composed primarily of carbonate rock. The pool lies at an elevation of approximately 2,300 feet above sea level and consists of an upper pool area and a subterranean cavern system.

The upper pool reaches a maximum depth of 46 feet and the cavern system, although only partially explored, is known to exceed 299 feet in depth. The water in Devil's Hole is a part of the local groundwater carbonate aquifer and the water surface is approximately 50 feet below ground level.

Conservation Agencies Assist

Throughout the past 25 years, conservation agencies have made various attempts to protect the fish. In 1952, the area was designated as a noncontiguous portion of the Death Valley National Monument, and was placed under the supervision of the National Park Service.

Subsequently, with the increased human population and continued demand for agricultural products, areas surrounding Devil's Hole began to be developed for crop cultivation and so pumping wells to obtain ground water became necessary for irrigation.

After initiation of intensive pumping, the falling water level in Devil's Hole became evident. At this time the Bureau of Sport Fisheries and Wildlife, along with other agencies, became vitally concerned with the annual drop in the water level.

Water Drop Dooms Fish

Field studies, conducted by the U.S. Geological Survey, were initiated and immediately related the lowering water level directly to the pumping operation. Approximately at this time the Desert Fishes Council came into being, with its initial emphasis placed on the survival of the pupfish. The U.S. Geological Survey concluded that continued pumping of ground water indicated that the water in Devil's Hole would eventually drop to a level where reproduction of this species might become impossible.

Carol James conducted research for a Master's thesis at the University of Nevada at Las Vegas, which discovered that virtually all pupfish reproductive and feeding activity was confined to the shelf just under the surface of the water. Dr. Robert Miller of the Museum of Zoology, University of Michigan, and one of the foremost experts on desert fish, agrees with the findings of Carol James and has done additional research to substantiate her conclusions.

Upon establishing the relationship between pumping ground water and the falling water level; and between the falling water level and pupfish feeding and reproduction, the Department of Interior formally requested the pumping be stopped from four critical wells.

The pumping did not stop, so on July 22, 1973, the Department of Interior requested the Department of Justice to initiate litigation to prevent continued pumping which influences the existing water level which is restricted by Federal rights. At the present time, the Federal District Court in Nevada has the case under advisement.

Other Alternatives Suggested

Following the period of initial interest in this species, other alternatives were suggested for conserving the pupfish. These alternatives included development of an artificial shelf and lighting over the shallow shelf in Devil's Hole, transplanting the pupfish to other springs in the area, and transporting the fish for attempted aquarium culture. While these alternatives were being considered, Bureau of Reclamation biologists investigated conditions in the vicinity of Hoover Dam, looking for an area to place a refugium. It was known that warm springs flowed out of the rocks and into the Colorado River in this area. Since the optimum temperature for pupfish is approximately 92° F., warm spring water was a requirement.

The Spring Was Found

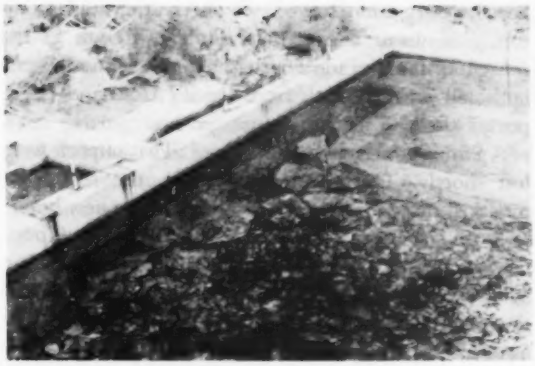
In early 1971, a spring was found below Hoover Dam which appeared to have water characteristics and temperature similar to those at Devil's Hole. Following additional investigation of the water supply and the availability of the site, a proposal to develop a pupfish sanctuary at this site was presented to the Desert Fishes Council.

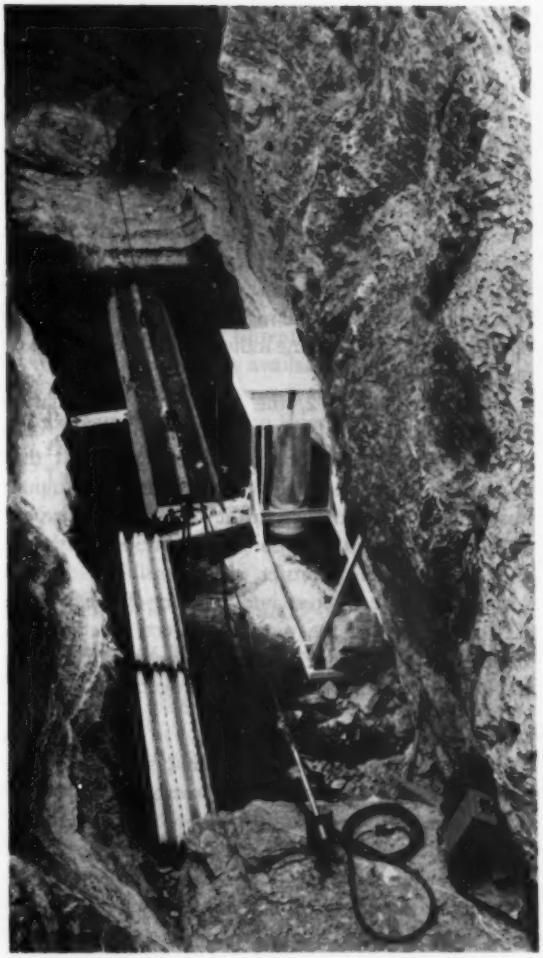
After obtaining approval of the Council to proceed with such a structure, Reclamation allocated funds and assigned personnel to plan and construct the facility. With additional funds from the Bureau of Sport Fisheries and Wildlife and excellent cooperation from the Nevada Department of Fish and Game, National Park Service, and other land-use agencies, as well as the University of Nevada at Las Vegas, development of the refugium began in January 1972, and was completed in August 1972.

Substrate Is Transported

In late September 1972, the Nevada Department of Fish and Game, the Bureau of Sport Fisheries and Wildlife, National Park Service, and the Bureau of Reclamation transported substrate from Devil's Hole to the sanctuary. After construction was completed in late August 1972, testing of water quality, quantity, and temperature and a thorough cleansing of the sanctuary were accomplished.

Planarians, snails, beetles, and algae from Devil's Hole were also introduced into the tank. On Octo-





Top. *Water enters the pupfish refugium through the deep end on the right and exits on the left through the outlet weir. The dark splotches on the bottom of the tank are algae, one of the major natural foods of the Devil's Hole pupfish.*

Bottom. *In Devil's Hole artificial lighting has been setup to stimulate algae growth. The shallow shelf where most feeding and reproduction occurs is in the foreground. The shallow shelf in the background is an artificial floating shelf added to provide for additional feeding and breeding.*

ber 2, 1972, after 2 weeks of observation and monitoring of water chemistry and algae growth in the refugium, the Nevada Department of Fish and Game collected seven pupfish from Devil's Hole and transported them to the refugium.

A 96-hour bioassay was initiated. Two pupfish were lost shortly after transfer. However, the remaining five thrived and appeared content in their new home. Following the successful bioassay period, 20 adult pupfish were collected at Devil's Hole by the cooperating agencies and transported to the refugium in Reclamation's helicopter on October 13, 1972. One dead pupfish was removed from the refugium 2 days later. Additional planarians, snails, and beetles from the Devil's Hole area were introduced by biologists of the Bureau of Sport Fisheries and Wildlife.

Transplant Appears Successful

From October 2 through November 12, 1972, daily observations were continued to determine the survival of these fish, to monitor the water temperature and breeding behavior, and to test adequately the overall operation of the refugium. By October 21, 1972, it appeared that the initial transplants were successful. In fact, biologists were pleasantly surprised to discover that reproduction was taking place in the tank. Close observation since that time indicated that several young pupfish were present.

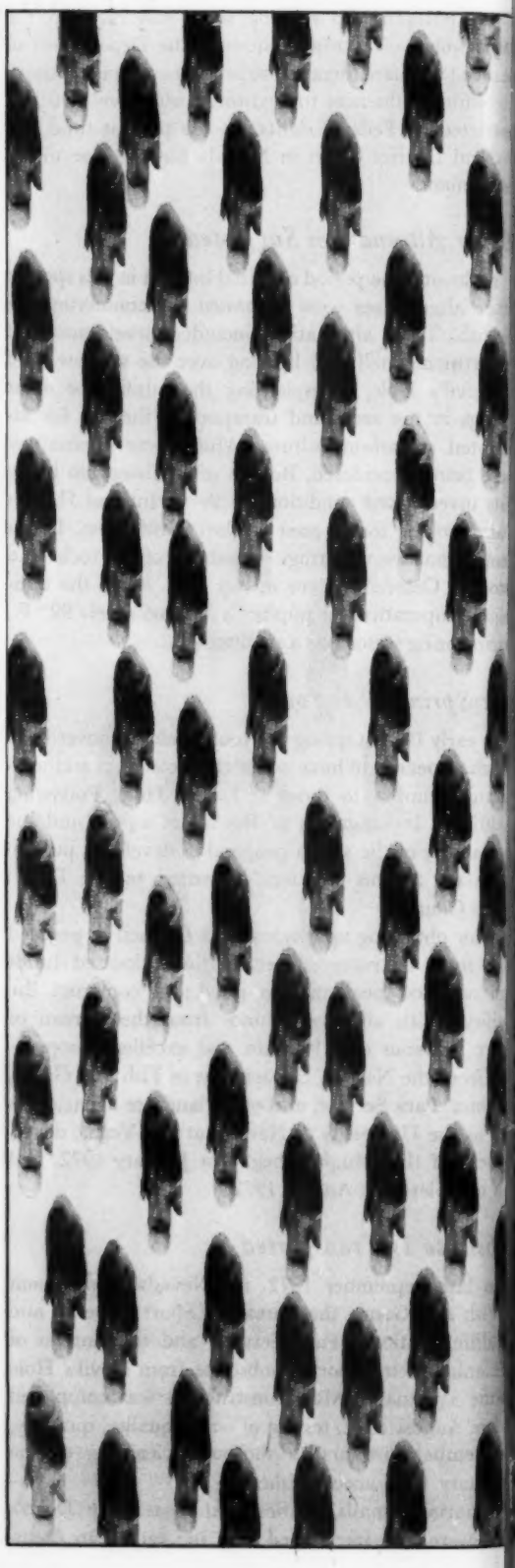
November 13, 1972, the Bureau of Reclamation completed its part of the agreement to design, construct, and test operation of the refugium. At that time, the management responsibility for the refugium was officially turned over to the Nevada Department of Fish and Game and to the Bureau of Sport Fisheries and Wildlife. This transfer of responsibility did not deemphasize the interest and support of the Bureau of Reclamation in the pupfish project. Reclamation intended only to avoid becoming involved in the fish and wildlife responsibilities of these agencies.

Subsequent Observations

Observations on December 1, 1972, indicated that, as nearly as it was possible to discern, all the adult pupfish were surviving and appeared to be adapting well to the conditions of the tank. At least six young fish were surviving and growing rapidly. Spawning activity was continuing and the possibility exists of additional young fish begin produced during the winter months.

On only one occasion predation by an adult upon a young pupfish was observed.

The pupfish sanctuary was developed through the concern and efforts of the Bureau of Reclamation, the Bureau of Sport Fisheries and Wildlife, the Nevada Department of Fish and Game, the National Park Service, the Desert Fishes Council, and other entities.



It was developed through the cooperative pooling of expertise, manpower, and funds, and it has been successful to this point.

The apparent success of the refugium is an indicator of the potential that exists but it should not yet be considered a total success. Survival of adults and reproduction of more young through a 1-year cycle will better indicate the potential for long-term success.

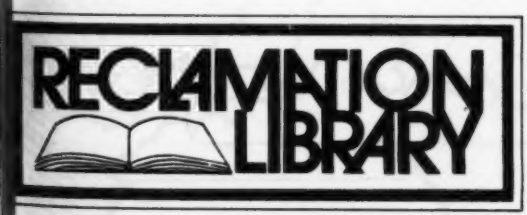
Additional introduction of fish from Devil's Hole will be necessary to develop sufficient genetic heterogeneity to insure continuous vigor of the population. A major breakthrough has, however, been accomplished since this is the first habitat other than Devil's Hole in which pupfish have produced young which survived and grew for more than a few days.

May Be a Future Success

However, only in the future, if success continues, can the refugium be considered a total success. Success will be realized when enough young are annually recruited to sustain a reproducing population. We are especially hopeful that cropping certain pupfish in the refugium can be undertaken, to use them for experimental purposes aimed at perpetuating the species. Managing the refugium will take a great deal of time, effort, and patience from all agencies.

This 10- by 20-foot refugium, containing a few of the world's last remaining pupfiish, provides a remarkable example of the cooperation that can be developed among different agencies in response to public demands. It is an outstanding example of the multiple-use concept directly associated with Bureau of Reclamation projects.

In the event that the refugium fish evolve into a subspecies, which sometimes happens when an animal is forced to live in a foreign or severely modified environment, then the refugium is not the answer for saving the remaining original pupfish (*Cyprinodon diabolis.*) If the evolution in the refugium diverges from that in Devil's Hole, other alternatives must be found to save these tiny fish.



The Federal Reclamation Program—its impacts, issues and future considerations. A current overview dealing, not only with the historical development of the Reclamation program, but with the impact it has had on the Nation's economy, agriculture, hydroelectric power, recreation, municipal and industrial water, etc.

This report also deals with major issues surrounding the Reclamation program, such as project evaluation, water pricing, and repayment. It also discusses future considerations that must be made in continuing the Federal Reclamation program.

Copies of this publication may be obtained from:
Bureau of Reclamations, Code 450
Department of the Interior
18th and C Streets, N.W.
Washington, D.C. 20240

Report of the United States Delegation Visit to the Soviet Union. This report covers the delegation's visit to electric power transmission and power generation facilities in the U.S.S.R. (see the article in this issue, "Americans Get Charge from Russian Powerplants.")

Copies of this publication may be obtained from:
Bureau of Reclamation, Code 910
Department of the Interior
18th and C Streets, N.W.
Washington, D.C. 20240

"New Design Criteria For USBR Penstocks," by H. G. Arthur and J. J. Walker, and *"Arch Dam Design: State of the Art"* by M. D. Copen and L. R. Scrivner, two papers by Bureau authors, first published in ASCE proceedings are available at:

Engineering and Research Center
Bureau of Reclamation Room 104
Denver Federal Center
Denver, Colorado 80225

Answers to Water Quiz:

1. Tomato has the highest—95 percent, sunflower seed has the lowest—5 percent. 2. Since some of the water collides with the bank and erodes it, and some is forced down to erode the bed, and material from the eroded area is deposited downstream on the same side, the net result is that the river curves more sharply. 3. True. Ground water might take 135 years to travel laterally through a single mile of soil. 4. (A) illustrates the most porous rock. An example of (A) would be sandstone, which is 47.6 percent porous; by contrast, the porosity of clay is only 25.9 percent as illustrated in (B). 5. False. Water molecules in ice are held in a relatively rigid geometric pattern by their hydrogen bonds, producing an open porous structure. Liquid water has fewer bonds, more molecules can occupy the same space, making liquid water more dense than ice. That is why ice floats. 6. 1/10,000.

YESTERDAY IN OUR MAGAZINE

THE RECLAMATION ERA—1950

Rainmaking in Arizona

by Ben Avery, *The Arizona Republic,* Phoenix, Ariz.

Here in Arizona's Salt River Valley—the cradle of western reclamation where the vision of manmade dams to store flood waters for use during the recurring droughts of the Southwest gave birth to the national Reclamation Act—men have another vision.

They envision filling those reservoirs by manmade rain.

Rainmaking didn't originate in the Salt River Valley, but the drought-battered farmers of this valley were the first to take it seriously. As far back as 1910 a self-styled rainmaker came to the valley, found ready backers for his mystical project, and left in the middle of the night, $3,000 richer.

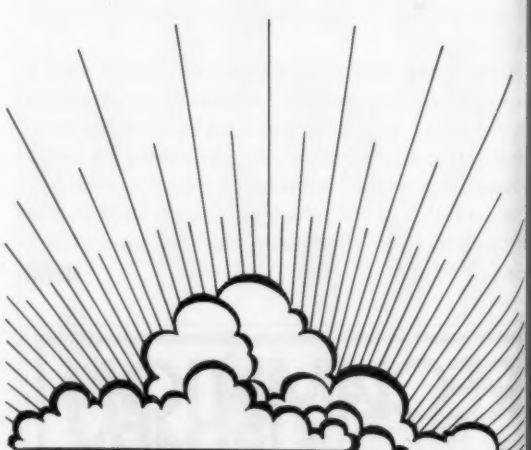
That unfortunate experience with rainmaking didn't slow the Arizonans, however, when they first heard about the rainmaking experiments of Dr. Irving Langmuir and his protégé, Vincent Shaefer, at the General Electric Laboratories in Schenectady, N.Y.

The *Arizona Republic* sent its managing editor, Harvey L. Mott, and Dr. Amos Hoff, head of the science department of Phoenix College, Ariz., to Schenectady, N.Y., to see if the scientists could be prevailed upon to shift their experiments to Arizona.

As a result, the newspaper itself went into the rainmaking experimental work, cooperating closely with Langmuir and Shaefer. A DC–3 was chartered to cast dry ice into cloud formations, and the first artificial rain was made to fall over Roosevelt Dam on July 16, 1947. The newspaper kept its work secret for several months, however, until the results had been closely established. . . .

During the summer of 1949 the experimental work was continued. Meantime, the research branched from dry ice to use of silver iodide and other agents. . . .

Despite all this work and the many developments of the past 3 years, however, all concerned still regard rainmaking as in the experimental stage. But the results obtained here . . . and in other parts of the United States, Hawaii, Canada, and Australia are regarded as definite proof that man can cause the sky to spill its clouds behind his reservoirs and thereby increase the value of his reclamation work.



TODAY

RECLAMATION ERA—1973

Project Skywater

From its somewhat tenuous beginning in Arizona 26 years ago, cloud seeding has mushroomed into a major field of study.

Today the Bureau of Reclamation is studying the potential benefits of precipitation and stream runoff of winter cloud-seeding programs over 12 mountainous river basins in 10 western States.

The work in this field is part of the Bureau's Project Skywater program of precipitation management. It is directed toward future operational cloud-seeding programs in some or all of the areas to assure more nearly adequate supplies of water in critical parts of the West.

The studies are consonant with President Nixon's 1972 State of the Union message urging "more imaginative use of America's great capacity for technological advance and to direct it toward improving the quality of life for every American."

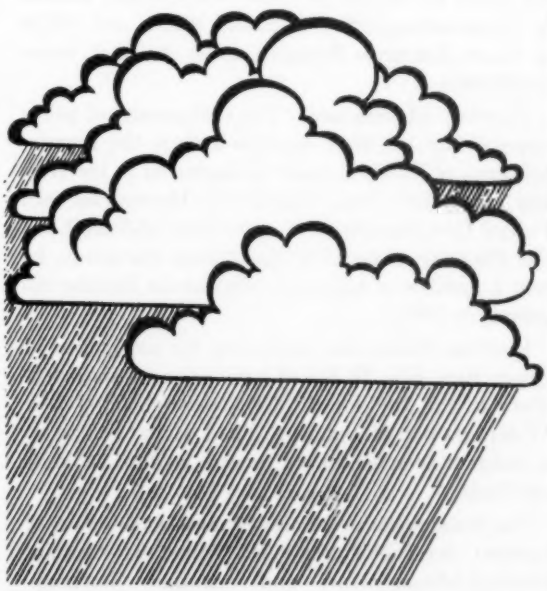
River basins to be involved in the studies, and the States affected, are as follows:

Upper Colorado, including the Green River (Colorado, Utah, Wyoming); Rio Grande (Colorado, New Mexico); Truckee, Humboldt, and Walker (California, Nevada); Sacramento (California); North Platte (Colorado, Wyoming); Gila (Arizona, New Mexico); Snake (Idaho, Wyoming); Upper Missouri (Montana, Wyoming); San Joaquin (California); Deschutes (Oregon); Bear-Wasatch (Idaho, Utah, Wyoming) and Yakima (Washington).

The Bureau of Reclamation currently directs research programs involving limited cloud seeding in parts of the Upper Colorado, Rio Grande, North Platte, Upper Missouri, Truckee, San Joaquin, and Yakima River Basins.

Through its Division of Atmospheric Water Resources Management in Denver, the Bureau has engaged in research since 1962 to determine if cloud seeding can be employed economically, efficiently, and in a socially acceptable way to augment precipitation and stream runoff in specific areas of the Nation.

Since *The Reclamation Era* reported rainmaking in Arizona in 1950, much research has been done. But, much more remains to be done to achieve the program's objectives.



news NOTES

Ottis Peterson Retires

Ottis Peterson, Special Assistant to the Commissioner and Director of Information in the Bureau of Reclamation, retired on March 2, 1973. He is a Federal career employee of 30 years, 27 of which he spent with the Bureau. He served in the capacity of Director of Information with four Commissioners of Reclamation.

"Pete" plans to pursue a career in free-lance writing and consulting in Boise, Idaho.

Interior Realignment

On February 6 Secretary Rogers C. B. Morton signed Departmental Order No. 2951, realigning and reassigning departmental functions and responsibilities and on the same day, President Nixon announced the nomination of Jack O. Horton, 35, a native of Wyoming, to be Assistant Secretary of the Interior for Land and Water Resources.

The new grouping of Interior Bureaus and Offices will place the Bureau of Land Management, Bureau of Reclamation, Office of Saline Water, and Office of Water Resources Research under Assistant Secretary Horton.

Secretary Morton said, "The realignment of policy responsibility for these agencies reflects the interdependence of land and water management in the West and nationwide." Since March 1972 Horton had been Federal Co-Chairman of the joint Federal-State Land Use Planning Commission for Alaska. Previously, he held a number of high-level positions in Interior beginning in 1969.

President Nixon also announced the nomination of former Rep. John H. Kyl of Iowa to be Assistant Secretary of the Interior for Congressional and Public Affairs and that Nathaniel P. Reed will be staying on as Assistant Secretary of the Interior for Fish, Wildlife and Parks.

The realignment order also establishes the offices of Assistant Secretary-Energy and Minerals; Assistant Secretary-Management; and Assistant Secretary-Program Development and Budget.

Worldwide Bids Invited for Turbines and Generators at Grand Coulee Dam

Bidding for the contract to supply and install second set of three record-size turbine-generators f the Third Powerplant at Grand Coulee Dam w opened to worldwide competition.

The three turbines and generators to be installe will be the second set in the Third Powerplant whic is now under construction at Grand Coulee Dam o the Columbia River in central Washington State.

The turbines, with as much as 960,000 horsepowe and the generators with up to 700,000 kilowatts capacity, will give the project approximately 6 millio kw of capacity, making it once again the largest the western hemisphere and one of the largest in th world. Plants of approximately similar capacity a under construction in Russia. The original set of generators at Grand Coulee Dam had a capacity 108,000 kw each, but 11 units have since been rewoun to increase their capacity to 125,000 kw.

The Third Powerplant at Grand Coulee Dam a ready has an international aspect since it was mad possible by the Columbia River Treaty with Canad which would supply more water for year-round oper tion of the additional capacity at Grand Coulee Da and other downstream facilities on the U.S. side of th border. The power benefits accruing from the add tional storage in Canada and added generating capa ity in the U.S. are to be shared by the two countrie

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You Are Invited To The . . .

NATIONAL WATERSHED CONGRES

This Congress, conceived and fostered by the N tion's leading agricultural, conservation, and industri organizations, is holding the 20th Congress June 3- 1973, at the Holiday Inn Plaza in Wichita, Kans.

"Land Use in Watersheds" is the theme of this yea Congress. The presentations and discussions will cent on the manner in which upstream watershed projec affect the use of land resources.

All persons interested in water and land resour development are invited to attend and participate this 20th Annual Congress. Sessions will be arranged t provide time for questions and discussion from th floor.

A $10.00 registration fee includes a copy of th proceedings, and admission to all sessions.

For additional information, write or call:

NATIONAL WATERSHED CONGRESS
1025 Vermont Ave., N.W.
Washington, D.C. 20005
Telephone: (202) 347–5995

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